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Range extension of *Acanthomysis hwanhaiensis* Ii, 1964, to the San Francisco estuary, California, and notes on its description (Crustacea: Mysidacea)

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Abstract.—The range of *Acanthomysis hwanhaiensis* has been extended from Korea to the San Francisco Bay estuary, California, presumably as the result of ballast water discharge from ocean-crossing vessels. The species is described here because the previous description is out of print and difficult to obtain. Two verified exotic mysid species, and potentially a third, have previously been reported to inhabit the San Francisco Bay estuarine system.

The large amount of shipping from the Far East that enters the San Francisco Bay estuary has brought many exotic marine invertebrates along with it (Cohen & Carlton 1995). Since 1987 eight exotic copepods, most probably transported in ship ballast water, have been discovered (Orsi & Ohtsuka 1999). In addition, two Mysidacea, *Acanthomysis aspera*, common in the coastal waters of Korea and Japan, and *Acanthomysis bowmani*, a species with strong similarities to taxa from the coastal waters of China and Korea, have been found (Modlin & Orsi 1997). A third mysidacean, *Deltamysis holmquistae*, which was possibly introduced, was described from the estuary (Bowman & Orsi 1992). To these we add a fourth mysid species, *Acanthomysis hwanhaiensis* Ii (1964), a Korean native.

Ii (1964) first described *Acanthomysis hwanhaiensis* from specimens collected in waters around Ryons Mai Island, Hae Ju Bay, Whang Hae do District, Korea. Although his descriptions are complete, the monograph that contains the descriptive material is out of print and somewhat difficult to obtain. Consequently, we have provided descriptive information and illustrations of several key identifying characters for those specimens of *A. hwanhaiensis* obtained in the San Francisco estuary.

The native mysid fauna of the San Francisco Bay estuary consisted of *Neomysis mercedis*, *N. macropsis* (now *Alienacanthomysis macropsis*), *N. kadiakensis*, *N. ravi*, and *N. costata* (now *Holmesimysis costata*) (Tattersall 1932). These species were all taken during a survey of San Francisco and San Pablo bays in 1912 and 1913 by the USS *Albatross*. Surveys conducted in 1997 and 1998 by the California Department of Fish and Game only collected specimens of *N. kadiakensis*, *N. mercedis*, and *A. macropsis*.

Methods.—All samples were collected by the California Department of Fish and Game (CDFG) with a tow-net mounted on sled-type runners and towed on the bottom for 10 minutes. A General Oceanics meter measured water flow through the net. Mesh size was 505 μm, net mouth diameter 76 cm, and net length 3.35 m. Samples were preserved in 10% buffered formalin with rose bengal dye added to help distinguish the mysids from detritus.

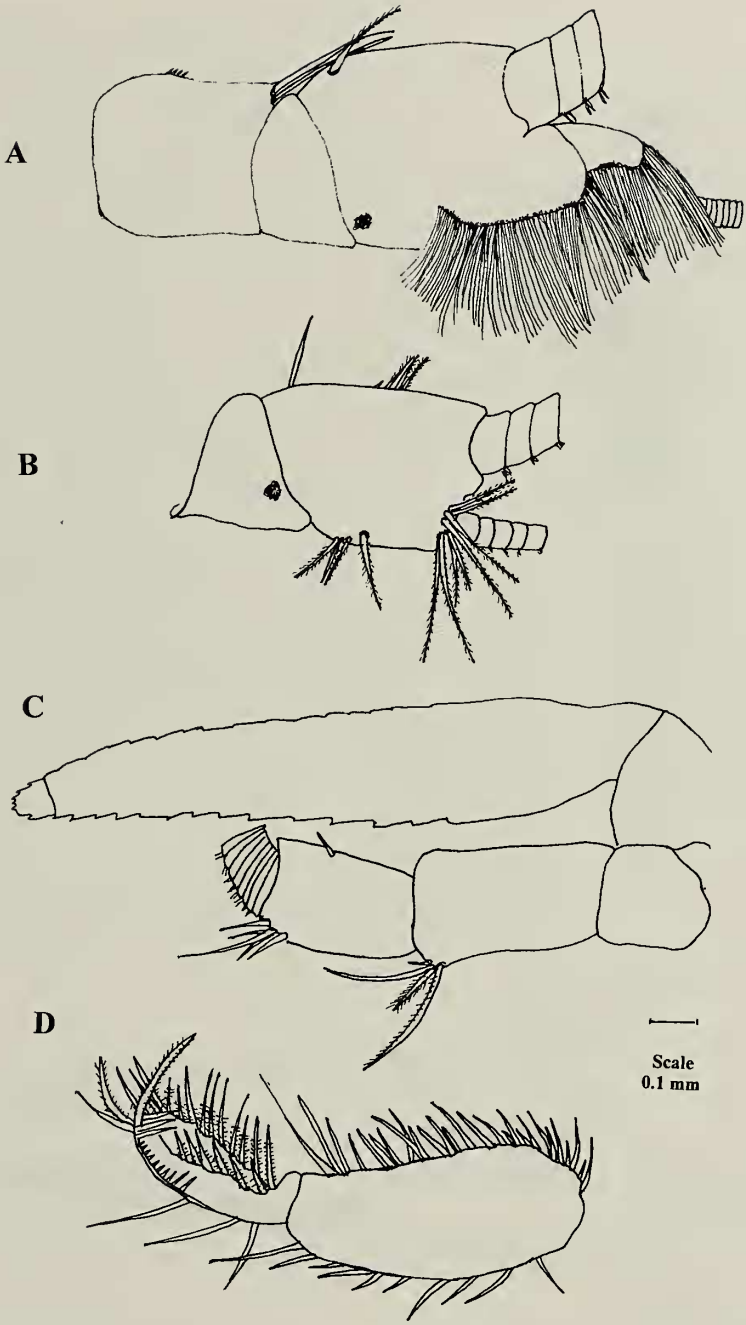

Fig. 1. *Acanthomysis hwanhaiensis* Ii: A. Antennular peduncle, male, 11.1 mm; B. Antennular peduncle segments 2 and 3, female, 12.00 mm; C. Antennal peduncle and scale, male, 10.0 mm; D. Mandibular palp, male, 11.1 mm.

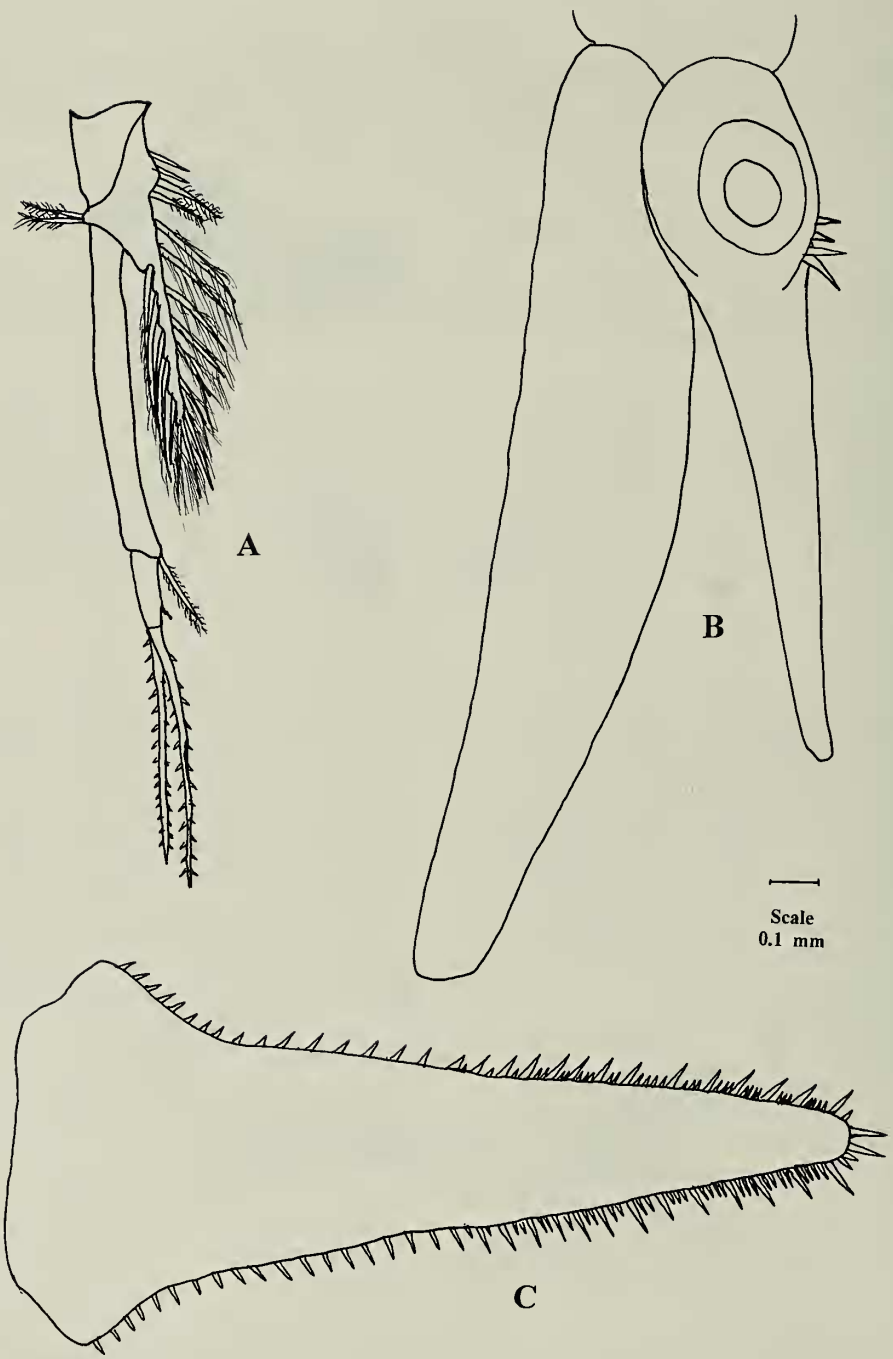

Fig. 2. *Acanthomysis hwanhaiensis* Ii: A. Fourth pleopod, male, 10.8 mm; B. Uropod, male, 11.1 mm; C. Telson, male, 11.1 mm.

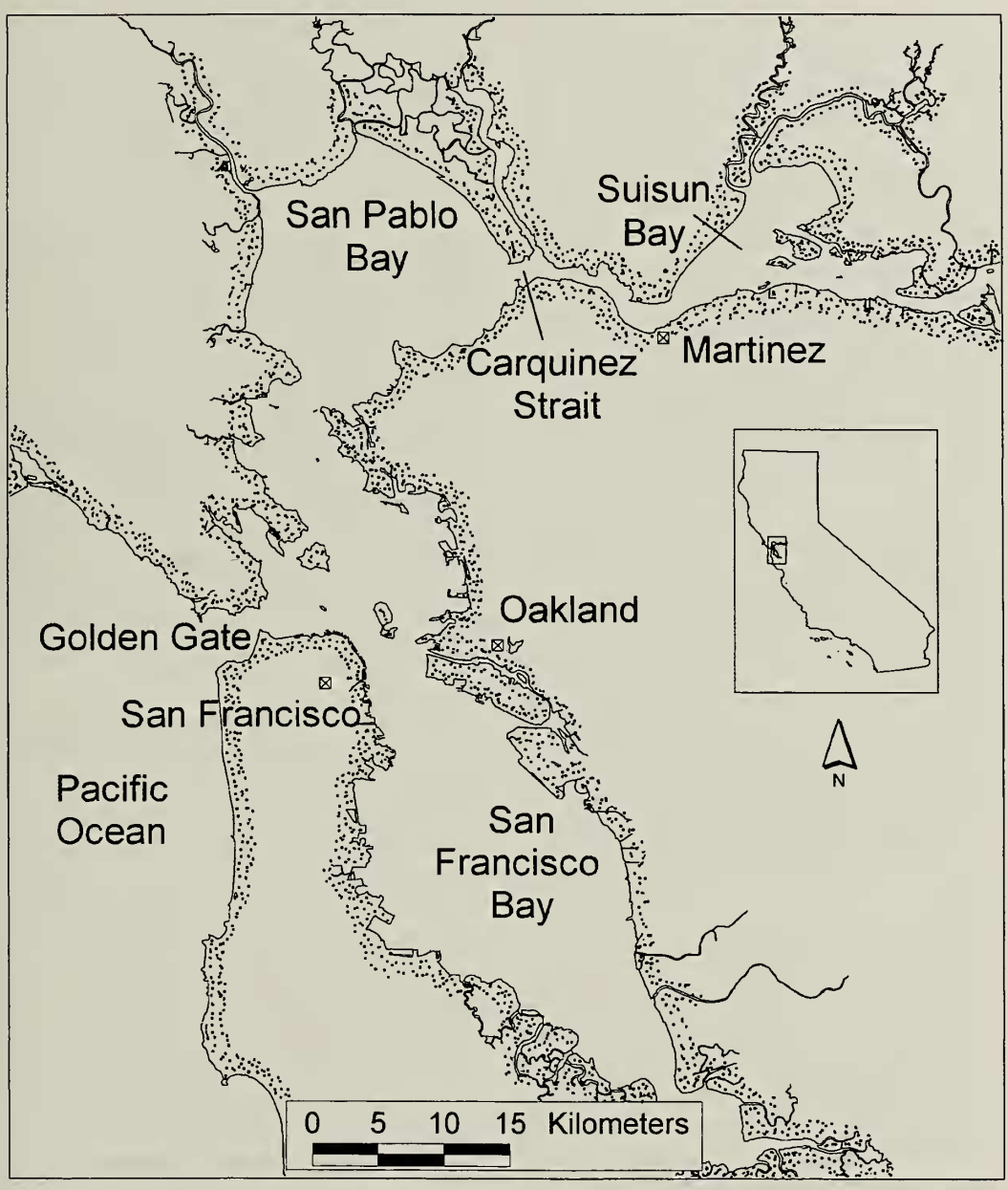

Fig. 3. San Francisco estuary survey area of the California Department of Fish and Game.

Acanthomysis hwanhaiensis Ii, 1964
Figs. 1–2

Material examined.—11 ♂♂, average size = 10.2 mm, range 9.5–11.2 mm; 5 ♀♀, average size = 10.9 mm, range 9.6–12.6 mm. Five ♂♂ and 2 ♀♀ specimens from the San Francisco Bay collection are on deposit at the USNM of Natural History, Smithsonian Institution, catalog number USNM 291489.

Description.—Antennular peduncle, male (Fig. 1A) 3-segmented; combined length of segments 1 and 2 about 1.3 times length of segment 3; segment 1 with a

group of 4 minute setae on middle of dorsal-lateral margin, 3–4 long setae distal-laterally; segment 2 triangular without setae; segment 3 robust, length to width ratio about 1.0, single proximal plumose seta along dorsal–lateral margin; male lobe conspicuous, heavily setose with fine setae. Female (Fig. 1B) segments 1 and 2 identical to that of male, segment 3 longer than that of male, length to width ratio about 1.4, with 7 plumose setae distally, 4 plumose setae along medial margin, 5 plumose setae laterally, and one spine-like seta directed ventrally on proximal margin. Medial pigmented spot on preserved specimens visible on segment 3 of males and segment 2 of females.

Antennal peduncle (Fig. 1B) 3-segmented; proximal segment 0.6 times length of segment 2, without setae; segment 2, 1.25 times length of segment 3, with a distal-medial group of setae composed of long and small naked setae, a plumose seta and long, robust seta with marginal spinules; segment 3 with distal-medial group of 4 subequal setae and 1 long naked seta, a single medial seta laterally; scale, blade-like, 1.4 times as long as peduncle, setose all around, articulated tip 0.06 times scale length.

Mandibular palp (Fig. 1C) 3-segmented; segment 1 inconspicuous; segment 2 about twice as long as segment 3, robust, medial margin setose along entire length with long, naked setae, lateral margin with 10 naked setae along length; distal segment triangular in cross-section, medial pad surrounded by about 20 robust setae with spinules, lateral margin with 3 long naked setae, apex with 1 naked and 2 long setae with spinules, a row of minute denticle-like spines distal-laterally.

Male fourth pleopod (Fig. 2A) short, length does not reach distal margin of sixth abdominal somite; proximal segment of exopod thick, about 7 times as long as distal segment, short plumose seta on distal-medial edge; distal segment with small inconspicuous naked seta on medial-distal edge, apex terminating in two long setae, apical setae about 5 times length of distal segment and armed with denticle-like spines along entire length; endopod unjointed, about 0.7 times length of proximal segment of exopod.

Uropod (Fig. 2B) exopod blade-like, about 1.3 times length of endopod, setose all around margin; endopod, margins strongly taper distally, with 4 spines along medial margin near statocyst ventrally, setose all around margin.

Telson (Fig. 2C) linguiform, about 2.1 times longer than width at base, lateral margins with about 30 long subequal spines throughout interspersed in distal half of telson with smaller spines about 0.5 times length of longer ones, number of shorter spines between longer ones increases from 1–4 distally, 1–2 short marginal spines in ultimate position, apex with pair of longer spines.

Remarks.—Except for the differences in the size and setation of antennular peduncle segment 3, males (Fig. 1A) and females (Fig. 1B) are morphologically identical.

Ecological notes.—*Acanthomysis hwanhaiensis* was first taken in San Francisco Bay in September 1997. It has been found at mean water column salinities from 9.8 to 30.4 psu. The range of this species in the estuary encompasses all of San Francisco and San Pablo bays, and Carquinez Strait to Martinez at the western edge of Suisun Bay (Fig. 3). Its highest density, 35.8 individuals/m^3, occurred in San Francisco Bay at a bottom salinity of 30.4 psu.

Acknowledgments

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